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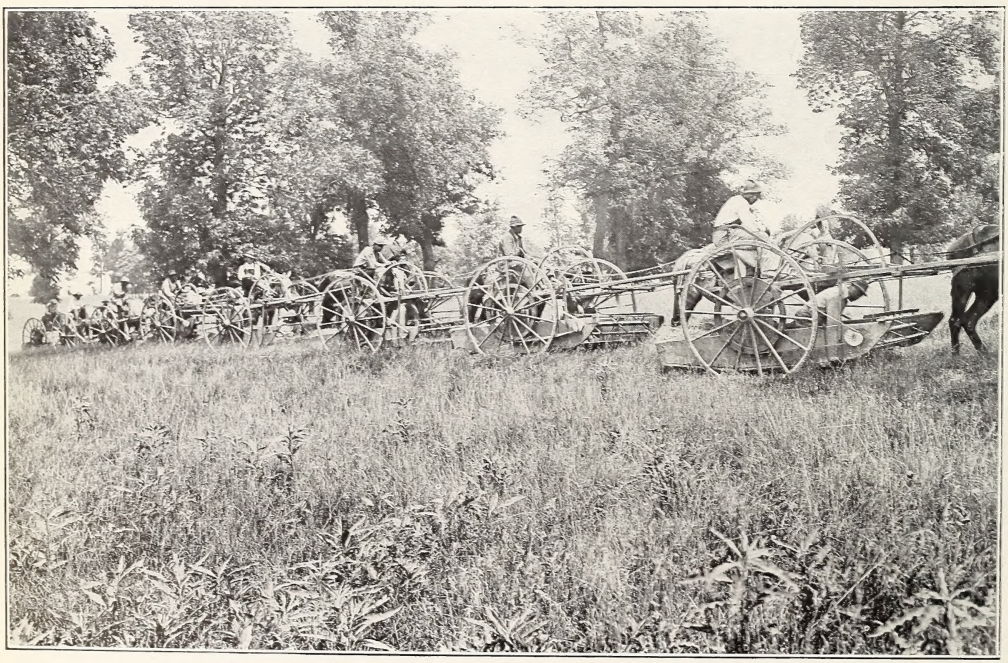

STRIPPING BLUEGRASS SEED IN KENTUCKY.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 19.

B. T. GALLOWAY, Chief of Bureau.

KENTUCKY BLUEGRASS SEED:

HARVESTING, CURING, AND CLEANING.

BY

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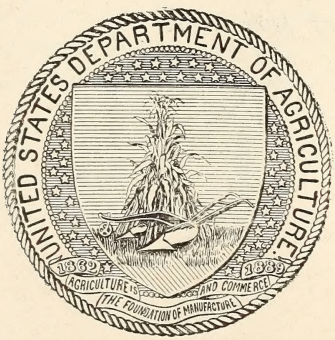

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., January 30, 1902.

Sir: I have the honor to transmit herewith a paper entitled Kentucky Bluegrass Seed: Harvesting, Curing, and Cleaning, and respectfully recommend that it be published as Bulletin No. 19 of the Bureau series. The paper was prepared by Mr. A. J. Pieters, botanist in charge of seed laboratory, and Mr. Edgar Brown, assistant botanist, both of Botanical Investigations and Experiments, and was submitted by the Botanist.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

The seed of Kentucky bluegrass forms an important item in the grass-seed trade of the eastern United States, both in the domestic market and for export. In the absence of precise statistics, it may be stated that the annual crop averages from 200,000 to 300,000 bushels, with a value of $200,000 to $300,000. In the progress of our studies in the seed laboratory a surprising variation was found in the percentage of germination of this seed. It was suspected that the vitality of the seed was injured at some stage in the process of harvesting or curing. An investigation was therefore instituted which has involved an examination, by Mr. Pieters and Mr. Brown, of the field operations of the growers in Kentucky during the harvesting seasons of 1900 and 1901, together with an extensive series of germination tests conducted in Washington. This investigation, the first results of which are herewith published, has demonstrated conclusively that the frequent low germination of Kentucky bluegrass seed is in reality due to improper treatment during the process of curing the crop, which results in overheating the seed and destroying its vitality. The investigation has demonstrated, further, that this overheating is preventable. It is believed that a drying apparatus can be used which will obviate the difficulty and take the place of the expensive hand labor or expensive storage facilities which otherwise are necessary. Further experiments relative to such apparatus are planned for the coming year.

FREDERICK V. COVILLE,
Botanist.

OFFICE OF THE BOTANIST,
Washington, D. C., January 21, 1902.

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KENTUCKY BLUEGRASS SEED: HARVESTING, CURING, AND CLEANING.

INTRODUCTION.[a]

Among pasture grasses there are none that take higher rank than the bluegrasses. Scattered throughout the north temperate portions of the globe, the various species afford, often in great abundance, natural pasturage of the best quality. This is nowhere more the case than in the United States, where a single species, the Kentucky bluegrass (*Poa pratensis*), has made famous one of the most beautiful and richest regions of this country.

DISTRIBUTION OF KENTUCKY BLUEGRASS.

This species is distributed almost throughout North America and is common in the Northeastern and Middle States, but reaches its best development in the rolling country of Kentucky, Missouri, and Iowa. The bluegrass region of Kentucky consists of gently rolling limestone slopes, with every uncultivated rise and hollow covered with a carpet of bluegrass, green in spring and fall and in early summer changing to great brown billows of the grass in seed.

From Kentucky the bluegrass was carried to Missouri and to Iowa, where it is now so well established that it lies at the foundation of the extensive and growing stock-raising industry. The story of how the bluegrass was brought to Iowa is told in Wallace's Farmer, and is worth quoting as part of the history of American agriculture. Mr. Wallace says:

> When we first came to Winterset in 1877 we noticed that the bluegrass was spreading from that town westward, the first seed having been brought to that region many years before by a traveler from Kentucky, who adopted the unique method of paying his expenses by giving bluegrass seed to the settlers.

QUALITY OF SEED REQUIRED BY THE FOREIGN TRADE.

It is well known to the trade that poor seed can not be sold to the European buyers. The foreign market demands not only heavy seed, but seed that will germinate well, and in many of the dealings between American and European firms bluegrass seed is sold at a price pro-

[a] The authors desire to express their thanks for the many favors and opportunities for study offered by the growers and cleaners of Kentucky bluegrass seed in and about Lexington, Winchester, and Paris, Ky., and also for the help and suggestions afforded by Professor Scovell, director of the Kentucky Agricultural Experiment Station, and Professor Garman, entomologist and botanist.

portioned to the percentage of germination. Unfortunately, no such system prevails in the United States, and the domestic trade uses the bulk of the bluegrass seed that has been spoiled by careless handling.

ADULTERATION.

Another matter seriously affecting the quality of the seed is the adulteration of Kentucky bluegrass seed with that of Canada bluegrass. These seeds resemble each other closely, and more than one firm, even among those doing business in and near Kentucky, has sold adulterated seed. Canada bluegrass undoubtedly has its place, but that place is where Kentucky bluegrass does not succeed. When the latter is wanted, the Canada seed is worthless or worse than worthless, and the Kentucky farmers have reason for protesting against a practice injurious to their pastures.

SOURCE OF THE MARKET SUPPLY.

The Kentucky bluegrass seed for sale on the American market is all home grown. Although the bluegrass as a pasture and meadow crop

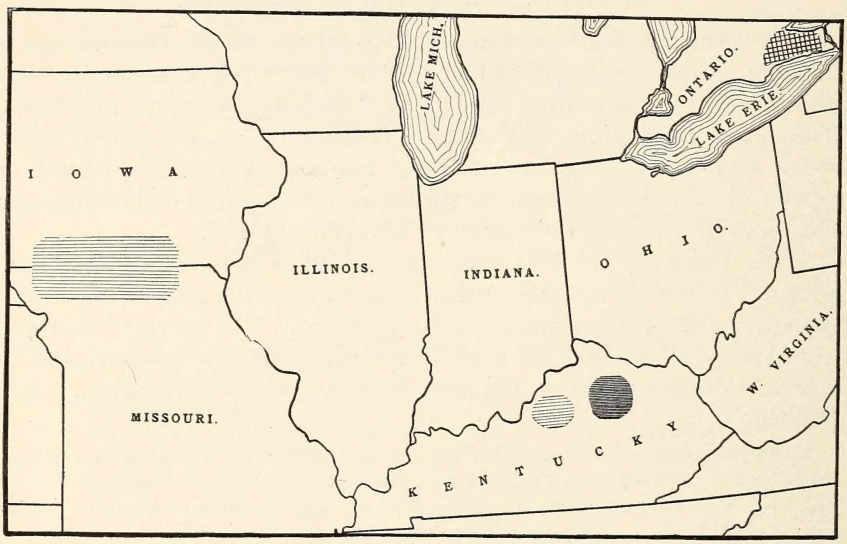

FIG. 1.—Map showing areas in United States and Canada where Kentucky and Canada bluegrass seed are harvested.

The bluegrass region of Kentucky. The bulk of the Kentucky bluegrass seed is harvested from this area.

Areas in which a limited quantity of Kentucky bluegrass seed is harvested.

Area in which Canada bluegrass seed is harvested.

has spread over most of eastern North America, the harvesting of the seed is limited to a few localities (fig. 1). The best known, as well as

FIG. 1.—CATTLE IN BLUEGRASS PASTURE AT TIME OF HARVESTING.

FIG. 2.—STRIPPING BLUEGRASS SEED IN IOWA.

the most important of these, is in Kentucky, where the counties of Bourbon, Fayette, and Clark, in the heart of the bluegrass region, produce the greater part of the seed crop of Kentucky. The adjoining counties of Scott, Montgomery, Woodford, Franklin, and Jessamine also produce some, and small quantities are doubtless harvested in other parts of the State. Most of the seed is secured within a radius of 25 miles from the center of a triangle formed by lines connecting the cities of Lexington, Paris, and Winchester. A few years ago this seed was first harvested in Iowa (Pl. II, fig. 2), where, in 1897, one man gathered 11,200 bushels in Lucas County. Since that time a cleaner has been put up in Creston, Union County, and during 1900 this mill turned out 6,000 bushels of "fancy," all gathered in the vicinity of Creston. Seed is also gathered at points in Missouri, and a little in Illinois.

FACTORS CONTROLLING THE PROFITABLE HARVESTING OF SEED.

The first requisite to profit in gathering the seed is, of course, an abundant growth of the grass, free from other plants. The profitable use of comb strippers is confined to districts having a clay soil. On sandy soil the plants are pulled up. Where rotary strippers are used this trouble is not experienced. Another controlling factor is the location of cleaning mills. Since the market chiefly demands fancy cleaned seed, Kentucky bluegrass seed can not be profitably harvested except within a reasonable distance from a cleaner. At present there are seven cleaners in Kentucky, one being located at Georgetown, one at Lexington, and five at Paris. There is one cleaner at St. Louis, Mo., and at least two at Kansas City, Mo., besides the one previously mentioned as being at Creston, Iowa. Most of these mills draw their supply of rough seed from the surrounding country, but in some cases it is brought to the mills in carload lots.

YIELD PER ACRE AND TOTAL CROP.

The amount of rough seed harvested per acre varies greatly. A good crop is 15 or 20 bushels per acre, while sometimes not more than 2 to 5 bushels are secured, though 25 bushels per acre is not uncommon. The amount gathered depends largely upon the amount of pasturing permitted. Cattle are allowed to graze freely (Pl. II, fig. 1) in the pastures from which seed is to be taken, because so long as they can eat the fresh leaves they avoid the flowers and seeds, although it is now generally recognized by the best growers that it is not profitable to pasture within about two weeks of the time of stripping. Horses, however, will eat the panicles in all stages and can not be permitted in a pasture when a crop of seed is wanted. It is well known in Kentucky that a "horse country" is not a good "seed country," while a "cattle country" produces good crops of seed as well as pasturage.

The total crop in Kentucky is variously estimated at from 300,000 to 600,000 bushels of rough seed, of which about 60 per cent is "fancy grade," the balance being "extra clean" or waste. The crop west of the Mississippi is much smaller, probably not over 25,000 or 30,000 bushels of "fancy;" but no reliable data are available for an estimate.

HARVESTING.

SEASON.

Kentucky bluegrass blooms in the latter part of May and the seed ripens during the second and third weeks in June. The average time for harvesting is about June 10 to 15. If the weather is favorable, the time for gathering the seed may be ten to twelve days, but usually the height of the season does not last more than five days. Stripping usually begins when the panicle is yellow and the culm still green. All the glumes should be yellow, except, possibly, a little green near the base of the youngest. At this time the grain is hard, or at least firm, and the after-ripening will enable it to reach full maturity. As the number of machines (Pl. I) needed by those growers who harvest two or three thousand acres, or even several hundred acres of seed, is large, and as the season is very short, it is not possible to wait until the fields are in the ideal condition before beginning the harvest. If this were done, some fields would become overripe and much of the good seed would be lost by shattering. When the seed is dead ripe, it becomes loosened from the spikelet and is often held by the web alone. In this condition it is readily beaten out by a severe wind or rain storm.

HARVESTING GREEN SEED.

The scarcity of machines, taken together with the competition among the buyers of uncured seed has encouraged the growers to begin stripping before the seed is sufficiently matured. Some bluegrass growers go to the extreme of harvesting the seed while the entire panicle is still green and the grain in the milk. By this means a greater weight is secured, and since all bluegrass seed is bought at the rate of 14 pounds per bushel, a greater number of bushels of uncured seed can be harvested at this time from a given area than if the seed is allowed to ripen. When such seed is cured by the producers this extra weight is, of course, lost; but some who sell directly from the strippers consider nothing but their immediate gain. Such seed heats more while curing than riper seed, does not after-ripen well, and is finally of poor quality, if not actually worthless. The temptation to strip seed too green is increased by the fact that most buyers make no distinction in price between different qualities of rough seed. Some of the larger buyers do, however, refuse to accept seed harvested too green and sometimes pay less for the crop of a farmer whom they know to be careless about curing.

FIG. 1.—STRIPPING BLUEGRASS SEED BY HAND.

FIG. 2.—STIRRING BLUEGRASS SEED WHILE CURING OUTDOORS.

METHODS—KINDS OF STRIPPERS.

The bluegrass seed is harvested both by hand and by horsepower machines. When Kentucky bluegrass seed was first collected, it was stripped off by hand and rubbed through sieves to clean it. At this time there was scarcely any demand for the seed, and the amount saved was consequently very small. The first improvement was what is known as the hand stripper (fig. 2), which soon became generally used. This stripper consists of a comb made of long, flat teeth set close together on the front edge of a small scoop-like box. The stripper is held in one hand and swung through the bluegrass (Pl. III, fig. 1) and with a dexterous twist is brought up again so that the seed stripped off falls to the rear part of the scoop. It is still used by colored men, women, and children to gather seed along the roadsides, in waste places, and in fields whose owners do not themselves intend to harvest the seed. The seed gathered by hand is brought to the buyers in lots of 1 bushel or more and was formerly the best in the market, but since the industry has been more fully developed the horse machines gather all of the best of the crop and leave little of good quality to be gathered by hand.

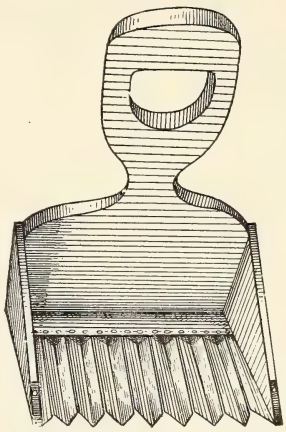

FIG. 2.—Hand bluegrass stripper.

The horsepower machines are of three kinds. The oldest and most commonly used is the comb stripper (Pl. IV, fig. 1), which consists of a platform hung on wheels and armed in front with a heavy steel comb, similar to that used in the hand stripper. The upper surface of this comb is smooth, and when harvesting a laborer kneels on the platform and cuts off the panicles as they are caught by the comb. For this he uses a broad, flat knife (fig. 3), which is passed back and forth over the comb. The stripper, which takes a breadth of between 5 and 6 feet, is drawn by one mule and has arrangements for raising and lowering the platform so as to accommodate it to the height of the grass. Since the culms are not usually of uniform height, much seed is lost, even with the best management. Where there are many weeds, or when timothy is abundant, these strippers can not be used to advantage. When the platform, which has raised sides and back, is full, the seed, mixed with the grass, weeds, and sticks, is put into large burlap sacks to be later hauled to the barn or grounds where the seed is to be cured. As the seed comes from the stripper

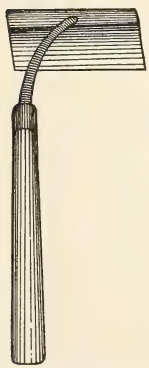

FIG. 3.—Knife used with comb stripper.

only 35 to 45 per cent will make fancy clean seed. Part of this loss is accounted for by the loss of water in curing and part by the chaff and straw taken out by the cleaners.

An improved form of the comb stripper (Pl. IV, fig. 2) has been designed, but only six of them have ever been built. This has an automatic knife for cutting off the heads as they are caught by the comb and an elevator which carries the rough seed away from the comb and drops it into a sack fastened at one side of the machine. When this sack is full the operator takes it off and leaves it in the field to be gathered up by the wagons that follow. The use of this machine makes a great saving of time, as there is no delay required to empty, and one man and one mule can operate it. It will doubtless admit of some mechanical improvement, but seems to work well and economically.

The rotary cylinder form of machine (Pl. V, fig. 1) is of more recent introduction, and is built on very different lines from the comb stripper. It consists of a wooden cylinder which is studded with large iron nails set in spirals, and which is hung in front of a platform upon which the seed is thrown. When in use the cylinder revolves rapidly, and the panicles of the bluegrass are struck by the nails, the seed, together with some straw and weeds, being thrown back into the receiving box. When the box is full the seed is put into sacks and hauled to the barns or curing grounds. With this form of machine it is possible to collect seed on sandy land where the grass would be pulled up by the roots with a comb stripper. Two mules and one man are required to operate it.

All of the styles are in use in Kentucky, but the old comb stripper is the only one at all common.

CURING.

Forty years and more ago, when only small quantities of bluegrass seed were collected, careful gatherers placed the piles of rough seed on large canvas sheets for one or two days during fair weather and finished the curing in the barns. This method is not practicable at present on account of the large quantity of seed harvested.

PRESENT METHODS.

There are two general methods of curing now employed: One may be called the indoor method (Pl. V, fig. 2, Pl. VI, fig. 1) and the other the outdoor method (Pl. III, fig. 2, Pl. VI, fig. 2). In either case the seed, mixed as it is with grass and weeds, is piled in ricks or windrows. These are preferably as low and narrow as possible and of any convenient length. When the curing is done in a building the length of the rick is limited by the size of the building, and consequently when

FIG. 1.—COMB STRIPPER, COMMON STYLE.

FIG. 2.—COMB STRIPPER WITH AUTOMATIC ATTACHMENT.

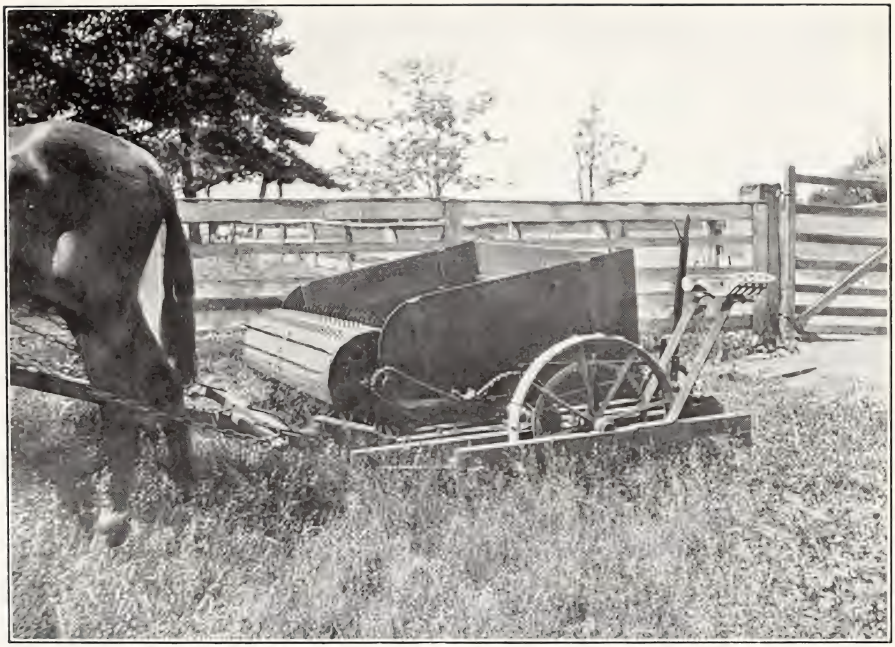

FIG. 1.—ROTARY CYLINDER STRIPPER.

FIG. 2.—CURING BLUEGRASS SEED IN OPEN SHED.

large quantities of seed are to be cured, the ricks are made 4 or 5 feet high by about 5 feet broad at the bottom. In the fields the ricks are frequently as large and are from 50 to 200 or more feet long.

To cure in the field a space is first mowed close, and is sometimes scraped, leaving a smooth, hard-packed clay surface. The seed is then ricked up on the dirt or on the short grass stubble, much of the coarse stuff, such as weeds and timothy, being shaken out and removed at this time. Some cure their seed out of doors for the first three or four days, during which time, if the weather is favorable, the seed becomes nearly dry. It is then taken to barns to finish curing, when it can be piled in larger ricks than would be safe with fresh seed. The curing of the entire crop is usually completed at about the same time, as the greener seed collected first takes a much longer time than that which is allowed to fully mature before stripping.

Until the last few years the curing was all done by the persons who stripped their own seed, and consequently in small lots. Recently it has become more and more the custom to sell the rough seed as soon as it is stripped to dealers who either have cleaners of their own or who cure it in large quantities and then resell before it is cleaned. This system has necessitated the handling of very large bulks of seed in one place—often more than there is room for or than can be sufficiently stirred with the available help. This is especially true when it is cured in buildings.

TURNING THE RICKS.

After the seed has been piled up it is of the utmost importance that it should be stirred often to prevent heating. For this a force of workmen is kept busy turning the seed over with forks and shaking out the straw, so that the air may get to every part. Every rick should be turned at least three times daily for the first four or five days.

HEATING.

When the seed is taken from the stripper and put into sacks it is fresh, moist, and mixed with more or less green stuff. The closely packed mass heats and, if left for even a short time before emptying, the seed becomes decidedly warm to the touch. When this warm mass is then piled into ricks and left for several hours the temperature rises rapidly, and, unless the seed is frequently stirred, soon reaches a point at which the vitality is greatly damaged. Naturally the temperature rises most rapidly and reaches the highest points in the center of large ricks, and when for any reason these are not turned often enough, the seed becomes "funked" or fired and assumes a gray, dusty appearance with a musty smell, the vitality of the seed

being damaged or entirely destroyed in proportion to the amount of heating allowed. When cleaned such seed is very dark-colored and always retains some of its mustiness.

RELATIVE MERITS OF INDOOR AND OUTDOOR CURING.

Whether indoor or outdoor curing is best depends mainly upon the weather at the time of curing, and, also, somewhat upon the floor space available for indoor work. The seed will unquestionably cure much quicker when put outdoors and exposed to the free circulation of air and the direct rays of the sun than when put in buildings in the shade. This is only the case, however, when the weather is clear, for whenever it rains the seed outdoors can not be stirred on account of the wet ground and the layer of wet seed on the outside, and in the meantime the center of the rick begins to ferment and heats very rapidly. The injury does not come from the rain itself, but from the heating, as seed is seldom if ever found wet more than one-half inch deep, even after a hard rain. When the curing takes place under cover the seed can be stirred constantly without reference to the weather, and although the process is slower it can be kept in good condition and free from injury by heating. The indoor curing is at all times safer if there is floor space enough, but it requires more labor and takes longer. Those curing indoors are, however, independent of the weather and can stir the seed whenever necessary. The greatest danger in connection with indoor curing is that, owing to restricted floor space, the ricks will be made so large (Pl. VI, fig. 1) as to develop a high temperature before they can be turned.

Both systems have as advocates equally successful and careful handlers, and under each good seed is made, the quality depending more on the conscientious care given by the curer than upon the method employed.

In fair weather seed may be cured outdoors in a week or ten days, while two or three weeks are required for indoor curing.

CLEANING.

The present development of the bluegrass-seed trade has been rendered possible by means of improved cleaning machinery. Before the civil war all bluegrass seed was cleaned by hand, negroes rubbing it through wire screens, their hands being protected by old boot legs. In the early years of the century lime and sand were used to assist in cleaning the seed; thus, Nicholson, in the Farmer's Assistant, published in 1814, says of *Poa pratensis:* "It yields plenty of seed, but this is difficult to sow on account of the filaments causing them to adhere to one another. To remedy this it is recommended to put them in newly slaked lime to separate them and then to be rubbed in dry sand."

FIG. 1.—CURING BLUEGRASS SEED IN WAREHOUSE LOFT.

FIG. 2.—CURING BLUEGRASS SEED IN RICKS OUTDOORS—50,000 BUSHELS ON ONE CURING GROUND.

To-day the seed is cleaned with powerful machinery, so that hundreds of bushels of "fancy" can be turned out in a day. The rough seed is first run onto a cylinder which is armed with steel teeth and which revolves in a jacket of heavy wire mesh. The grass is rubbed between the mesh and the cylinder and the seed rubbed out. It is then sifted and run through a bran polisher, or some similar machine, to loosen the wool, after which it is finally cleaned through one of the modern seed-cleaning machines, which blows out the wool, dust, and light seed, leaving the "fancy" grade of any desired weight per bushel. The seed demanded by the export trade must weigh at least 22 pounds to the measured bushel.

EFFECT OF CURING ON THE VITALITY OF THE SEED.

During the past summer a careful study was made of the temperatures in the piles of curing bluegrass seed. A stay of about four weeks in the bluegrass region of Kentucky during the harvesting season, with daily visits to the principal curing grounds, made it possible to collect a series of samples taken under known conditions as to the time of harvesting, length of time the seed had lain in ricks without turning, and temperature of the seed when the sample was taken. These samples were dried as soon as drawn and sent to the seed laboratory, where they were cleaned by hand and the cleaned seed tested for germination. The conditions from the time the samples were drawn to the completion of the germination test were the same for all samples. The results of the germination tests are shown in the tables following.

About 70 samples of seed were collected, part of them being average samples taken from large lots of seed that were being cured under the ordinary conditions, but at different stages during the process, while others were taken to ascertain the actual time and temperature of fermentation. In order to do this a quantity of seed was repeatedly placed in a rick on the ground as soon as brought in from the strippers and not stirred for several days. Thermometer[a] bulbs were placed in the piles when the seed was put on the ground, and samples were taken at frequent intervals from these piles, the temperature of the mass being determined at the same time.

GERMINATION TESTS.

The following tables show the results of the germination tests of the samples mentioned above.

[a] The temperatures of the piles of fermenting seed were taken with electrical thermometers of the pattern used in the Bureau of Soils and described in Bulletin No. 15, Division of Soils, U. S. Department of Agriculture. These instruments allowed the readings to be made as often as desired without removing the bulbs or in any way disturbing the temperature.

TABLE No. 1.—*Seed stripped June 20; put in rick on ground June 20, 6 p. m.*

Sample.	When taken.	Temperature, degrees F.	Part of rick.	Percentage of germination.
a	June 21, 10 a. m	140	Inside	0
b	June 21, 10 a. m		Top	79
c	June 21, 7 p. m	148	Inside	3
d	June 22, 5 p. m	130	do	0
e	Juue 24, 7 a. m	124	do	0.5

Table No. 1 shows the result of tests of samples taken from seed which was stripped on June 20 and put in a rick on the ground that afternoon about 6 o'clock. The next morning at 10 o'clock, after the seed had been in the rick for only sixteen hours, it had reached a temperature of over 140° F., and the sample taken at that time from the inside of the pile failed to germinate, while another sample taken at the same time from the outside of the rick gave a germination of 79 per cent. As the seed was practically killed at the end of the first sixteen hours, the samples taken later failed to germinate at all, or gave such a low percentage that they showed the seed to be of no value.

TABLE No. 2.—*Seed stripped June 19; put in rick on ground June 19, 5 p. m.*

Sample.	When taken.	Temperature, degrees F.	Part of rick.	Percentage of germination.
a	June 20, 10 a. m	130	Inside	75.5
b	June 20, 10 a. m		Top	92.5
c	June 20, 6 p. m	131	Inside	1
d	June 21, 10 a. m	140	do	.5
e	June 22, 5.30 a. m	145	do	0
f	June 22, 5.30 a. m		Top	77
g	June 22, 5 p. m	140	Inside	1

Table No. 2 shows the result with samples taken from seed stripped on June 19 and put in a rick on the ground that afternoon. The next morning, after about seventeen hours, the temperature was 130° F., and a sample taken from the inside of the rick germinated 75.5 per cent, while that taken from the top of the rick at the same time germinated 92.5 per cent. The temperature in this case did not run up as fast as in the case of the rick shown in Table No. 1, but the sample taken after twenty-five hours germinated only 1 per cent. After sixty hours the sample taken from the top of the rick germinated only 77 per cent, having fallen off about 15 per cent in two days from the effect of the heating, although on the outside of the rick.

TABLE No. 3.—*Seed stripped June 18; put in rick on ground June 18, 6 p. m.*

Sample.	When taken.	Temperature, degrees F.	Part of rick.	Percentage of germination.
a	June 19, 2 p. m	148	Inside	3
b	June 19, 2 p. m		Top	91
c	June 20, 10 a. m	142	Inside	.5
d	June 20, 6 p. m	132	do	.5
e	June 20, 6 p. m		Top	1.5
f	June 21, 10 a. m	104	Inside	.5
g	June 21, 10 a. m	[a] 153.3	do	.5

[a] This temperature was that recorded by a maximum thermometer, which was placed inside the rick and not removed until it was opened at the time the last sample was taken.

Table No. 3 shows the germination of samples taken from seed stripped on June 18 and put in a rick on the ground that afternoon at 6 o'clock. The next afternoon, after twenty hours, the temperature was 148° F., and the sample taken then germinated only 3 per cent, while that taken from the top of the rick at the same time germinated 91 per cent.

TABLE No. 4.—*Seed stripped June 18; put in sack on ground June 18, 10 a. m.*

Sample.	When taken.	Temperature, degrees F.	Part of sack.	Percentage of germination.
a	June 20, 10 a. m		Top	55
b	June 20, 6 p. m	134	Inside	39.5
c	June 21, 10 a. m	128	do	41
d	June 22, 5 p. m	135	do	9
e	June 24, 7 a. m	130	do	1

Table No. 4 shows the germination of samples taken from a single 10-bushel sack of seed stripped on June 18 and laid on the ground outdoors. As there was a smaller bulk than in the ricks the temperature did not run so high, but the vitality of the seed was steadily reduced and at the end of four days was practically destroyed.

TABLE No. 5.—*Average samples from bulk lots.*

Sample No.	When stripped.	When sampled.	Where cured.	Percentage of germination.
6	June 22	June 25	In barn (not stirred)	0
8	June 28	June 28	In warehouse	75.5
10	June 20	June 25	do	35
11	do	do	do	42
12	do	do	do	20
14	do	June 26	do	84
15	do	June 24	In barn	17
16	June 22	do	do	87
18	June 20	June 21	On grass	69
19	June 21	June 27	do	43
20	do	do	do	92
22	June 14	June 20	In barn	2
23	June 17	June 21	On ground	87
24	June 19	do	In house	78
26a	June 18	June 18	In barn	52
26b	do	do	do	77
27	June 19	June 27	do	81
28	do	do	In open shed	81
29	June 22	do	In barn	66
30	do	June 26	In warehouse	25
31	June 14	do	On ground	3

Table No. 5 shows the germination of 21 average samples taken from large lots of seed which were being cured in the ordinary way. Of these, 6 germinate 25 per cent or less and are worthless as commercial samples, while 9 germinate over 75 per cent and would be graded as first-class seed. The other 6 samples, germinating from 35 per cent to 69 per cent, would be considered poor to fair.

SUMMARY OF RESULTS.

These tests show that only half, or less than half, of the seed is cured in a way which makes it first quality and sufficiently good to be sold in the European market, where a large part of the best seed is sent. Radical changes should be made in the methods of curing. It is absolutely necessary that the seed should not be left twelve to sixteen hours without stirring, as the heating from fermentation will destroy the vitality of the seed in that time. When the curing takes place outdoors, with the possibility of not being able to stir the seed during a rain, the ricks should not be over 16 to 18 inches high nor more than 12 inches wide at the bottom. If they are made as small as this, the air will have a chance to circulate through them and prevent excessive heating.

The tests also show that this seed naturally has good vitality and that there is no reason why Kentucky bluegrass seed should not rank as high in respect to quality as clover or timothy seed.

ARTIFICIAL CURING.

An attempt was made to try the practicability of curing the rough seed by means of a commercial grain dryer, or a modification of it. A quantity of seed was sent to Chicago and dried very quickly and economically, but it had heated in transit, so that the samples taken when it reached Chicago failed to germinate. There would be no possibility of injury to the vitality of the seed if the drying was done at a low temperature and with a large blast of air. If the seed was only partly dried in some such manner it could then be handled with very little danger of heating, as the most severe fermentation takes place immediately after stripping, while all the water is in the seed and straw. A plant to thoroughly test this method of curing should be established the coming season, as its successful operation and adoption would mean a great saving in labor, as well as a great improvement in the quality of Kentucky bluegrass seed.

CONCLUSIONS.

1. Green seed of Kentucky bluegrass when put in ricks will ferment and reach a temperature of 130° to 140° F. in less than sixteen hours.
2. A temperature of 130° to 140° F. for sixteen hours or less will greatly damage if not entirely destroy the vitality of the seed.
3. Under the present methods of handling green seed it must be stirred at short intervals.
4. The seed must not be stripped till mature, as it is much harder to prevent fermentation in the immature seed.
5. Seed should always be put in small ricks, not over 18 inches high.
6. Seed can be cured to better advantage under cover in bad weather and outdoors in clear weather.
7. A plant for thoroughly testing artificial curing should be established at once.

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BULLETINS OF THE BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry, which was organized July 1, 1901, includes Vegetable Pathological and Physiological Investigations, Botanical Investigations and Experiments, Grass and Forage Plant Investigations, Pomological Investigations, and Gardens and Grounds, all of which were formerly separate divisions, and also Seed and Plant Introduction, The Arlington Experimental Farm, Tea Investigations and Experiments, and the Congressional Seed Distribution. Beginning with the date of organization of the Bureau, the independent series of bulletins of each division was discontinued, and all are now published as one series of the Bureau.

The bulletins published in the Bureau series are:

No. 1. The Relation of Lime and Magnesia to Plant Growth. 1901.
2. Spermatogenesis and Fecundation of Zamia. 1901.
3. Macaroni Wheats. 1901.
4. Range Improvement in Arizona. 1901.
5. Seeds and Plants Imported through the Section of Seed and Plant Introduction, etc. Inventory No. 9. 1902.
6. A List of American Varieties of Peppers. 1902.
7. The Algerian Durum Wheats. 1902.
8. A Collection of Economic and other Fungi prepared for distribution. 1902.
9. The North American Species of Spartina. 1902.
10. Records of Seed Distribution and Cooperative Experiments with Grasses and Forage Plants. 1902.
11. Johnson Grass: Report of Investigations Made during the Season of 1901. 1902.
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